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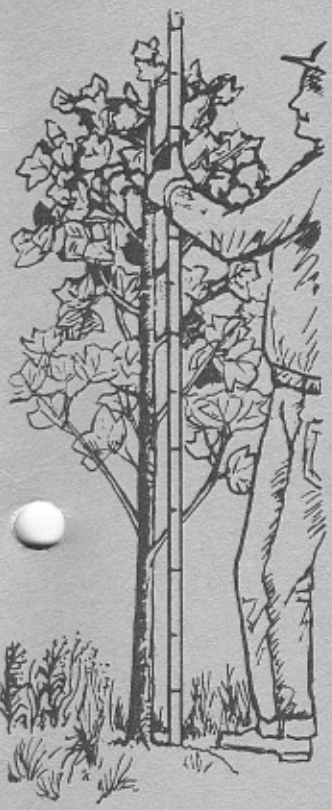

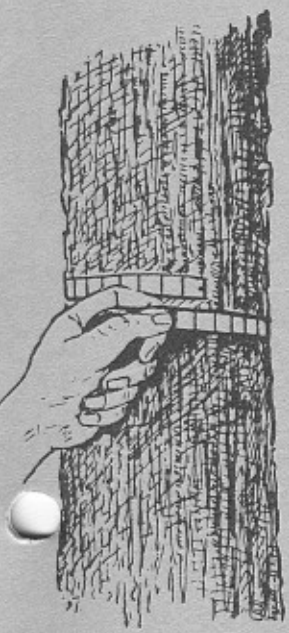

# Yield of Old Field Shortleaf Pine Plantations

Virginia Division of Forestry
Department of Conservation and Economic Development

# Yield of Old Field Shortleaf Pine Plantations in Virginia

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Over the last 20 years a total of 68 permanent one-fifth acre yield plots have been installed in old field shortleaf pine plantations, and 57 of these plots were used in this yield analysis. These 57 plots are in 40 different plantations located in 25 different counties of the piedmont and mountains of Virginia.

## Guidelines for Establishing Plots

1. Plots were not established in plantations where there was evidence of damage from fire or grazing.

2. Plantations had to be large enough to provide a "buffer" zone around each one-fifth acre plot.

3. Surviving pines had to be well distributed with no large openings.

4. Plots were not established in plantations which had excessive numbers of volunteer (i.e. non-planted) trees. When plot volumes were later calculated, all plots on which volunteer trees comprised more than 10 percent of the total merchantable volume were excluded from the yield analysis.

## Data Collected

1. All living, dead, and "missing" trees were tallied. The estimate of "missing" trees was based on the spacing used: when no evidence of a dead tree could be found where it was thought that a seedling probably had been planted, a missing tree was tallied.

2. All living trees, both planted and volunteer, were measured to the nearest one inch DBH (diameter at breast height).

3. A sample of total tree heights, measured to the nearest foot, was obtained for each DBH class.

4. Where reliable planting records were not available, an increment borer was used to estimate plantation age.

## Computations

For each plot the following computations were made:

1. The tally of living, dead, and "missing" trees was used to estimate the number of seedlings planted per acre.

2. A graph was prepared of average total tree height over diameter at breast height. Curved average heights for each DBH class, from this graph, were used in volume computations.

3. Volume in cubic feet,[1/] outside bark, to a four-inch top outside bark was computed for all trees over 4.5 inches DBH.

4. Various published site index curves were screened using two methods:

   1. Three trees on each of seven different plots were cut down and sectioned. Stem analyses were carried out[2/], and graphs of height over age for each plot were compared with the various published curves.

   2. The various published curves were compared with actual height growth on 28 plots that were remeasured from 4 to 16 years after initial establishment (12 of the 28 plots were remeasured twice and five were remeasured three times).

The site index curves that were selected for use in this yield analysis were developed from data collected in old field shortleaf pine plantations.[3/] Site index was determined for each plot. Site index is the average total height in feet that dominant and co-dominant trees will attain in 25 years. One year was added to the age of each plantation to obtain age from seed for site index determination.

Age, Site Index, and Number of Planted Trees for the 57 Plots

The average age (years since planting) of the 57 plots was 24½ years and the average site index was 44. Plot distribution by age and site index is shown in Table I.

The number of seedlings planted on the 57 plots ranged from 770 to 1,620 and averaged 1,139. The number of planted trees surviving at the time the data were taken ranged from 490 to 1,050 and averaged 836. Plot distribution by number of seedlings planted and number of trees surviving is shown in Table 2.

1/ Smalley, Glendon W. and Bower, David R., 1968. Volume Tables and Point Sampling Factors for Shortleaf Pines in Plantations on Abandoned Fields in Tennessee, Alabama, and Georgia Highlands. Southern Forest Experiment Station, SO-39.

2/ Dr. Willard H. Carmean of the North Central Forest Experiment Station, U.S. Forest Service, kindly provided instructions for making the stem analysis.

3/ Smalley, Glendon W. and Bower, David R., 1971. Site Index Curves for Loblolly and Shortleaf Pine Plantations on Abandoned Fields in Tennessee, Alabama, and Georgia Highlands. Southern Forest Experiment Station, SO-126.

Table I. Number of Plots by Age and Site Index.

| | Site Index Class (25 year base) | | | | | |
|---|---|---|---|---|---|---|
| Age | 29-32 | 33-37 | 38-42 | 43-47 | 48-52 | Totals |
| 19 | | | 1 | | | 1 |
| 20 | | | | 3 | | 3 |
| 21 | | | 1 | 1 | 2 | 4 |
| 22 | | | 2 | 6 | 2 | 10 |
| 23 | 1 | 1 | 5 | 1 | 1 | 9 |
| 24 | | 1 | 2 | 2 | 1 | 6 |
| 25 | | | 1 | 2 | 2 | 5 |
| 26 | | | 1 | 1 | 1 | 3 |
| 27 | | | 1 | | 2 | 3 |
| 28 | | | | 3 | 2 | 5 |
| 29 | | 1 | 1 | 2 | | 4 |
| 30 | 1 | | | 2 | 1 | 4 |
| Totals | 2 | 3 | 15 | 23 | 14 | 57 |

Table 2. Number of Plots By Number of Seedlings Planted and Trees Surviving

| Planted Per Acre | Number of Plots | Surviving Per Acre | Number of Plots |
|---|---|---|---|
| 770 - 800 | 2 | 490 - 500 | 1 |
| 801 - 900 | 3 | 501 - 600 | 2 |
| 901 - 1,000 | 8 | 601 - 700 | 4 |
| 1,001 - 1,100 | 10 | 701 - 800 | 12 |
| 1,101 - 1,200 | 13 | 801 - 900 | 22 |
| 1,201 - 1,300 | 15 | 901 - 1,000 | 12 |
| 1,301 - 1,400 | 2 | 1,001 - 1,050 | 4 |
| 1,401 - 1,500 | 3 | | 57 |
| 1,501 - 1,600 | -- | | |
| 1,601 - 1,620 | 1 | | |
| | 57 | | |

*Analysis of Data*

*Merchantable cubic foot yields were related to age, site index, and number of surviving trees by regression analysis. The following equation accounted for 87 percent of the variation in yield among the 57 plots:* 4/

*Logarithm of Volume (cubic feet, outside bark, to a 4" top o.b.) =*

$$3.9086 + 14.8620 \left(\frac{1}{age}\right) - 1.7148 \left(\frac{1}{site}\right) - 1{,}110.68 \left(\frac{1}{age \times site}\right)$$

*At the average values for age and site index (24½ years and site 44) the standard error is ± 2 percent of the predicted yield and the standard deviation is from -13 to +15 percent of the predicted yield.*

*Numbers of surviving trees ranged only from 490 to 1,050 per acre, and 46 of the 57 plots had between 700 and 1,000 surviving trees. This restricted range may explain why plot yields were not related to numbers of surviving trees.*

*Yield Tables*

*Merchantable cubic foot yields by age and site index class are presented in Table 3. Table 4 presents the same yields in standard cords. A conversion factor of 90 cubic feet per standard cord was used to convert the cubic foot yields in Table 3 to standard cords in Table 4. The yields presented are for planted trees only (volumes of volunteer trees were not included in the analysis).*

*The yield tables were developed using plots that had good tree distribution and no large openings. The average plantation contains areas where poor early survival has resulted in poor tree distribution and/or large openings. In most plantations of any size, average yields should be expected to fall below the yields presented in the tables.*

4/ *Both site index and 1/site index were tried as independent variables, and the latter gave a better fit. Residuals from the above equation plotted over age and site index indicate the equation fits the data well. Residuals from the above equation plotted over number of surviving trees did not indicate any relationship, but number of trees and number of trees/age were both tried as independent variables. Neither made a significant reduction in the residual sum of squares after fitting 1/age, 1/site, and 1/age x site.*

*Table 3. Per Acre Merchantable Cubic Foot Yields (outside bark, to a 4 inch top outside bark).*

| | Site Index (25 year base) | | | | |
|---|---|---|---|---|---|
| Age | 30 | 35 | 40 | 45 | 50 |
| 20 | 554 | 1,038 | 1,661 | 2,396 | 3,211 |
| 21 | 625 | 1,138 | 1,783 | 2,529 | 3,343 |
| 22 | 699 | 1,238 | 1,902 | 2,656 | 3,469 |
| 23 | 772 | 1,337 | 2,016 | 2,777 | 3,585 |
| 24 | 847 | 1,434 | 2,127 | 2,893 | 3,697 |
| 25 | 923 | 1,530 | 2,236 | 3,004 | 3,813 |
| 26 | 998 | 1,624 | 2,341 | 3,110 | 3,903 |
| 27 | 1,073 | 1,717 | 2,441 | 3,212 | 3,999 |
| 28 | 1,148 | 1,808 | 2,540 | 3,311 | 4,090 |
| 29 | 1,223 | 1,896 | 2,635 | 3,406 | 4,176 |
| 30 | 1,297 | 1,983 | 2,726 | 3,493 | 4,258 |

*Table 4. Per Acre Yields in Standard Cords (outside bark, to a 4-inch top outside bark).*

| | Site Index (25 year base) | | | | |
|---|---|---|---|---|---|
| Age | 30 | 35 | 40 | 45 | 50 |
| 20 | 6.2 | 11.5 | 18.5 | 26.6 | 35.7 |
| 21 | 6.9 | 12.6 | 19.8 | 28.1 | 37.1 |
| 22 | 7.8 | 13.8 | 21.1 | 29.5 | 38.5 |
| 23 | 8.6 | 14.9 | 22.4 | 30.9 | 39.8 |
| 24 | 9.4 | 15.9 | 23.6 | 32.1 | 41.1 |
| 25 | 10.3 | 17.0 | 24.8 | 33.4 | 42.4 |
| 26 | 11.1 | 18.0 | 26.0 | 34.6 | 43.4 |
| 27 | 11.9 | 19.1 | 27.1 | 35.7 | 44.4 |
| 28 | 12.8 | 20.1 | 28.2 | 36.8 | 45.4 |
| 29 | 13.6 | 21.1 | 29.3 | 37.8 | 46.4 |
| 30 | 14.4 | 22.0 | 30.3 | 38.8 | 47.3 |